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ABSTRACT

There are two kinds of hereditary influence, genetic inheritance and biological inheritance, that may respond to environmental determinants. The ability to speak is one genetically produced aspect of being human, and research studies based on the assumption that speech is innate to humans have found that infants appear to pay particular attention to speech sounds as compared to other sounds of similar complexity, infants do not need to be coached in the motor skills involved in producing sounds, and the early language of children is universally similar in both grammatical form and meanings expressed. There are also biologically given capacities related to language--differences between individuals that influence language acquisition--that are activated through experience. Behavior genetic analyses using studies of twins reflect differences due to genetic influence in a particular environment. The study of hereditary influences is essential to building theories that supply information for future decision-making regarding children's individual learning differences. A genetic predisposition does not mean that environmental intervention is of limited value, but rather that a different environment in structure, kind of stimulation, and frequency and nature of reinforcements may be necessary for a child with that predisposition. (AEA)

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Hereditary Factors in Language Acquisition.

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The question, "Are there hereditary influences on language acquisition?" is one specific example of a group of questions that has been referred to as the heredity-environment question, or the nature-nurture issue. Such questions occupied a significant position in the early history of child development. However, the mainstream of early psychology in this country, dominated by behaviorism, largely ignored such questions. Learning theories assumed that behavior could be understood and controlled in terms of the environment. Such an orientation fit in well with a social-political worldview that persons were "created equal". Additionally, for a young and growing science it may have seemed more important to establish general principles than to consider apparent exceptions. More recently both society and the sciences have given increasing attention to individual differences and, perhaps then necessarily, to biological influences upon behavior and development. As a result not only do we now have the widely recognized subfield of behavior genetics but other behavioral scientists now feel free to make use of explanatory mechanisms involving heredity.

This paper will consider the extent to which this has been done, and seems necessary, in the area of language acquisition. I shall assume that the reader is generally aware of the basic phenomena of early language development. Additionally, one needs to know that language is often described as consisting of three simultaneously occurring elements: sounds which combine into units (the concern of phonology); the ordering of the units (the concern of grammar); and meaning (the field of semantics). My concern will be to analyze possible answers to the question "Why and how do we learn the spoken language?"

Determinants of behavior, or behavior change, include variables which may

be divided into the two large classes of environmental and biological determinants. Hereditary (genetic) influences are a major component of biological determinants.

There are two kinds of hereditary influence. One is the specific genetic inheritance associated with the species, homo sapiens. Because of our genes, there are some ways in which homo sapiens are like one another and different from other species, even the similar primates. In addition, there is a specific biological inheritance from our human ancestors, again carried most immediately by our genes, that makes us alike to or different from other individual humans to varying degrees.

Any genetic influence upon longuage could be carried by either or both of these sources and so both will be considered.

An obvious difference between humans and other species is that given a minimal language environment, almost all humans speak. If speech doesn't occur, we expect and find some sort of deviant condition--for example, deafness, or autism, or indications of brain damage. In this broad sense then, language obviously has a hereditary component; the ability to speak is one genetically produced aspect of being a human.

Recently it has been found that chimpanzees and gorillas can be taught to communicate by sign language. They are able to create original phrases not taught to them directly; further, it appears that Washoe, one of the best studied of these chimpanzees who now lives in an animal colony with other chimpanzees, is attempting to teach her adopted infant to use signs. It seems to me that this says nothing to negate the existence of genetically determined species aspects of language in humans. In the first place, only humans have a vocal apparatus easily used to create complex and rapidly produced sounds. In addition,

the complexity of the usual human language, whether speaking or using sign language, is much greater than that of any primate.

In addition to the general observation that all normal children learn language there is additional suggestive evidence that there are innate aspects of language. These findings, in brief, include the following.

1. Some researchers in the area of speech perception have concluded that infants appear to pay particular attention to speech sounds as compared to other sounds of similar complexity.

2. Infants do not need to be coached in the motor skills involved in producing sounds; Sounds produced in the babbling of a given infant include some that do not occur in the language around him; the infant's task seems to be to eliminate possible responses.

3. There are major differences in the average environment associated with social classes. There are both average IQ and general cognitive differences associated with these differing social class environments. Yet the average age of occurrence of the first word does not differ according to socio-economic class. Later differences between social classes do develop, especially with respect to vocabulary and ability to communicate meaning to others. Differences are either nonexistent or minor with respect to grammatical competence. While there may be differences in the kinds of grammatical rules exhibited in speech or in their closeness to "Standard English," grammars do exist and are equal in complexity.

4. Even casual observation suggests that parents do little if any direct tuition for aspects of language other than semantic ones. There is little if any correction of pronunciation in the early years. "Cute" mispronunciations may even be perpetuated by the parent. Typically, we ignore minor difficulties

with articulation even at 3 and 4 years of age. Only when children enter school is there a systematic screening for speech sound production and the initiation of therapy for a few.

Inappropriate grammar in the young is often ignored or if attended to the unself conscious technique used by parents and teachers often is to repeat the meaning with correct form. For example, "He goed away" may be followed by "Yes, he went away, didn't he?" A parent who says no is most likely to be correcting for truth content. "No, he just went upstairs."

Such observations while indicating that learning by reinforcement is not a major mechanism in language acquisition do allow for the possibility of learning by imitation.

5. Studies have been done of the early two- and three-word sentences in many languages over the world and for different backgrounds within these languages. Linguists and psychologists examining these data have concluded that early language is similar in both grammatical form and meanings expressed the world over. More importantly, these early grammatical forms are <u>not</u> like those the child hears spoken by adults. Although adults simplify their language for children, they still use a variety of ways,or surface structures, in order to express an underlying meaning. The hypothesized underlying meaning, which is often referred to as deep structure, may be transformed in various ways to produce differing forms with equivalent meanings (e.g., "the cat chased the mouse" and "the mouse was chased by the cat"). Early child language seems to be free of transformation and is like what is hypothesized to be in "deep structure."

6. There are some similarities across languages which are referred to as "language universals." Some examples follow. All languages make use of

the voiced sound, (e.g., buh) or voiceless sound (e.g., puh) as distinctive cues in speech. In all languages, nouns occur (although of course the particular sets of sounds for equivalent nouns will differ); verbs occur. Nouns and verbs appear as subjects and predicates in sentences. In all languages deep structure occurs and there are varied possibilities of surface structure. Transformation rules occur in all language so that it is possible to understand the relation between deep and surface structures. In each language there are certain things that are done with the language; these include stating relations, giving commands, asking questions and so on.

These findings taken as a group seem to me to make untenable any position that holds that we are entirely dependent upon experience for the acquisition of language. Instead it appears that there are some biologically given capacities related to language and that experience is necessary to activate those capacities. Theorists now generally hold such a nativist position; however, there are differences as to the nature and specificity of the hypothesized capacities. For example, some have suggested a Language Acquisition Device that is specific for at least some aspects of language. Others emphasize that language is one example of general cognitive-intellectual functioning and there are most likely innate capacities dealing with information processing generally.

It is possible to state an innateness hypothesis without specifying whether the mechanisms involved are specifically linguistic or more generally cognitive. An example follows from the book Language Development, by Phillip Dale.

"Children do not have to learn those features of the deep structure that are universal, nor do they have to eliminate those possibilities that are ruled out by the formal universals."

"The features of language that children must acquire from the speech around them are the unique features of this language, and they include the actual transformations of that language." (p. 99)

Up to this point I have emphasized the similarities in language and its acquisition and have suggested that there is evidence for a component that is hereditary and influential for all humans. However, there are also large individual differences both in the rate at which language is acquired and in the final level of language as measured by semantic abilities. We will now consider data relating to the role of between-individual genetic differences and any effects upon language acquisition. Behavior genetic analyses have used studies of twins more than any other method. In the twin study method, behavioral measures are obtained from identical, or monozygotic, twins (MZ) who have identical genes and from fraternal, or dizygotic twins (DZ) who differ genetically. There are a variety of ways of comparing the data for MZ and DZ twins so that the variance in scores may be partitioned into hereditary and environmental components. If there is a statistically significant component which appears to be genetic in origin, that characteristic is said to be heritable.

Studies asking whether the language performance of twins demonstrates heritability have been done by Chubrich (1971); Fischer (1973); Matheny (1973); Mather (1979); Mittler (1969); Munsinger and Douglass (1976); Koch (1966); and Waterhouse (1972). These studies differ greatly in the numbers of twins studied, the number of different measures used, and the ages and age range studied. Evidence has been found for a genetic influence in all aspects of language by at least one study. Generally, those studies that have a large sample size find heritability for all measures used. Mittler, who does have

a large sample, noted that although there were genetic influences for all measures some appeared to have a stronger hereditary component than others. This variation was also noted by Mather for her total group. However, the major purpose of the Mather study was not just to obtain heritability estimates for an entire group but to look at estimates separately for two groups that differed in social class. When this was done, it was found that some measures were genetically influenced for both social class groupings but that these were different for the two groups. What does this mean? It seems to me unreasonable to suggest a greatly different genetic make up for children whose parents differ in education and occupation. Heritability estimates are statistics that reflect differences due to genetic influence in a particular environment. Biological factors may be differentially potent in different environments. For example, it is known that the long term effects of prematurity differ for children in middle class as contrasted to lower class homes. We need to consider the similar possibility that environment influences heritability as manifested in various aspects of language skills.

Let us now consider why one might be interested in the question of hereditary influences. A first obvious reason is that we examine genetic factors for reasons of theory building. Scientists want to enumerate as completely as possible variables that matter when the question is asked "Why did this happen?" With respect to language, theorists have hypothesized genetic influences since they seem necessary to explain the observed data. In addition to making us feel we better understand, a complete theory is often practical in that it gives us information to help us decide what to do. A simple example: if we know that the occurrence of the first word is heavily genetically influenced we won't assume that language environments are different (and one adverse)

if one child is talking at 12 months and another is not. The general question, "When there is a problem in development, is the environment solely responsible?" is an important one largely because it is related to blame and guilt. While the information that a child's problem may have been brought about in part by a genetic predisposition is often helpful in reducing parental or teacher guilt, this sometimes also results in an unfortunate, and inaccurate interpretation. A genetic predisposition does not mean that environmental intervention is useless or of limited value. It may well mean that a different environment will be necessary for a child with this predisposition. This different environment could involve such things as the structure in the environment, the kind of stimulation, the frequency and nature of reinforcements, and so on.

I suspect that by now you have become aware that there are implications in what I am saying about spoken language acquisition for those concerned with reading acquisition and its problems. But let me make explicit the relationship. A relation is suggested first of all by the fact that a child with a higher level of language skills is more likely to have the necessary reading readiness skills. Further the skills of speaking and reading are analogous in two major ways: reading, like speech, is a combination of a variety of skills that are interrelated; there is evidence that reading, like speech, is heritable.

For these reasons I invite you to consider with respect to reading acquisition the following. The finding of a genetic or biological influence may be true only for some environments. Even when hereditary or biological influences are found or hypothesized, intervention may well be useful. Intervention, or remediation, may then be conceived of as a search for the kind of environment in which a hereditary predisposition is not crucially manifested.

Finally, let me note that these suggestions refer only to ways of thinking about intra-species genetic differences.

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